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(56) Publications considered in assessment of patentability:

DE	27 29 566 B2
DE-OS	21 04 673
AT	3 52 253
US	38 27 437
US	33 34 630

(54) Stone extractor for transurethral removal of ureteral stones

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DRAWINGS PAGE 1

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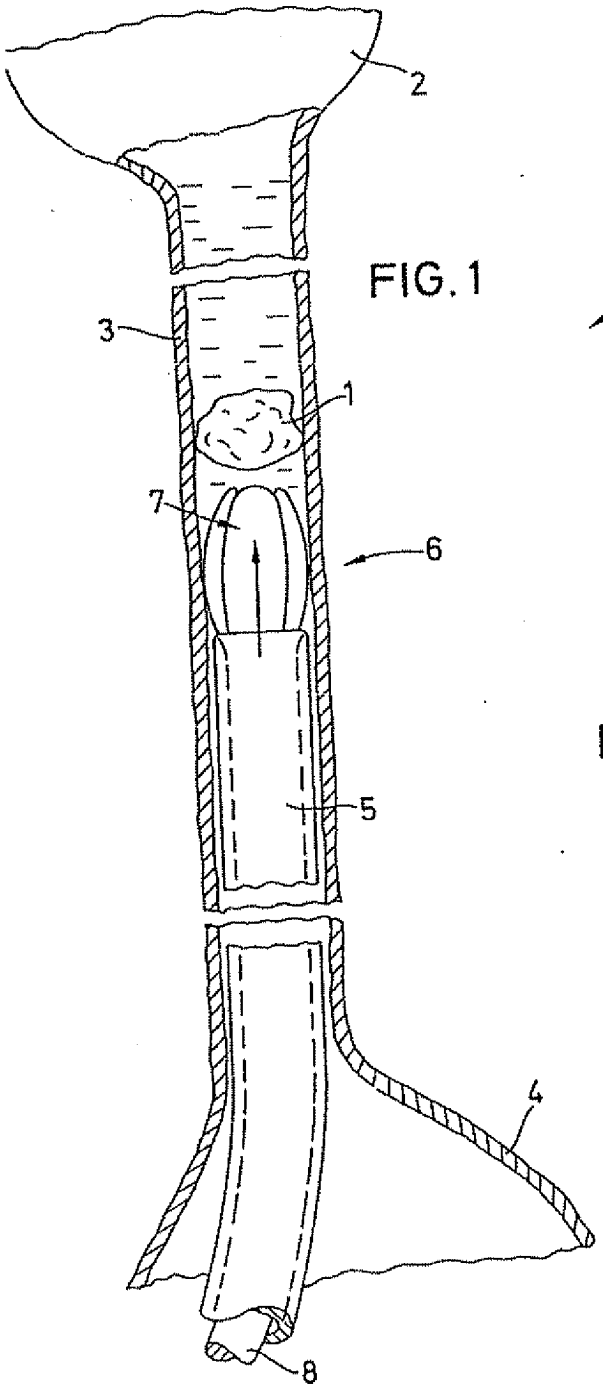


FIG. 1

FIG. 2

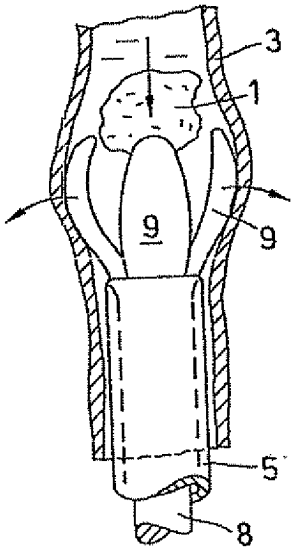
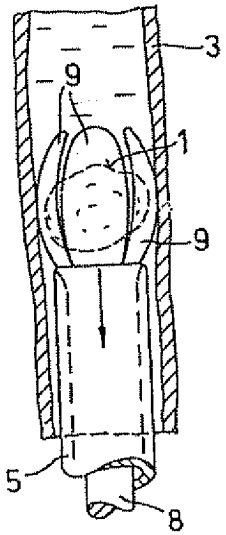


FIG. 3



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Claims

1. Stone extractor for transurethral removal of ureteral stones, consisting of a flexible catheter tube and a flexible traction and thrusting instrument which is longitudinally displaceable in the catheter tube to operate a catch device provided on the end of the catheter tube nearest the patient for the ureteral stone, which consists of a segmented head with wings, which can be opened and closed like jaws through movement of the traction and thrusting instrument, **characterized by the fact that** the curved leaf-shaped wings running inwards seen in the cross section (**9**) of the cuplike, shell-shaped head (**7**) are each swivel mounted around a transverse axis (**10**) and are supply connected to the traction and thrusting instrument (**8**) by means of tabs (**12**) in such a way that at a movement in the direction of the head (**7**) they open and at a movement in the opposite direction they close.

2. Stone extractor for transurethral removal of ureteral stones, consisting of a flexible catheter tube and a flexible traction and thrusting device which is longitudinally displaceable in the catheter tube to operate a catch device provided on the end of the catheter tube nearest the patient for the ureteral stone, which consists of a segmented head with wings, which can be opened and closed like jaws through movement of the traction and thrusting instrument, characterized by the fact that the curved running leaf-shaped wings (**17**) going inwards seen in the cross section of the cuplike, shell-shaped head (**16**) are arranged overlapping each other like an iris diaphragm and are held spread away from each other by elastic connections, for example springs (**19**) or rubber buffers, at the opening of the head (**16**), that the catheter tube (**5**) has a stiff section running conically outwards (**5*a***), in which a conical part (**17*a***) of each wing engages and that each wing (**17**) has an edge curved inwards (**17*b***) on its lower part, which is engaged from behind by a protruding collar (**8*a***) of the traction and thrusting instrument (**8**).

3. Stone extractor for transurethral removal of urethral stones, consisting of a flexible catheter tube, which has a catch device for the urethral stone on the end nearest the patient, which is formed by a cuplike, elastic end component of the catheter tube, the opening of which can be constricted, characterized by the fact that the end component of the catheter tube (**5**) is provided on its free end with an elastic section running conically outwards (**34**), to one end (**35*a***) a pull cord is attached, of which one part essentially runs around in a cross-sectional plane of the section (**34**) and is arranged so as to be able to be displaced in a circumferential direction to the section (**34**) and of which the other part (**35*b***) is loose on the end of the catheter tube (**5**) farthest from the patient and is passed out of this.

4. Stone extractor as claimed in claim 3, characterized by the fact that the pull cord which turns around in a ring (**35**) is arranged on the outer or inner side of the conical section (**34**) or in the material of the same.

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Description

The invention relates to a stone extractor for transurethral removal of ureteral stones in accordance with the above concepts of claims 1, 2 and 3.

For treatment of urethral stones by mechanical removal the so-called Snare Catheter is known. This has a catheter tube, to the forward end of which a traction device, e.g. a filament or the like is attached, which enters the catheter tube at a certain distance from the forward end and runs to the back end, that is, the operative end. When the traction device is pulled, the forward end of the catheter tube forms a snare. With this snare it should be possible to grasp the stone located in the ureter as with a lasso and pull it out of the ureter. Snare Catheters are also provided, with which a double snare can be formed with the help of two traction loops. Furthermore urethral stone extractors are known, in which several longitudinally running fine wires are housed in the forward end of the flexible catheter tube, which are attached firmly to the flexible traction and thrusting instrument on one of their ends. The free ends of the bundle of wires are likewise attached together in a rounded tip. As soon as the bundle of wires is pushed out of the catheter tube, the free wires endeavor to bulge radially outward, whereby an elongated, somewhat bulging basket is formed. The wires can hereby take on a helical configuration. Because the wires bulge outward, these form a free space between them, which should make it possible to get the stone into the inner space of the basket, so that it can be held in the basket. When the catheter tube is pulled out the stone should be brought along.

In the operation of both of the above named, previously known catheters, a precondition for catching the stone in the relatively narrow urethra, is that the forward catheter end can be passed by the stone, i.e. that one must be able to get the catheter past the stone stuck in the urethra. Only then can the stone be caught by the loop of the catheter tube or by the wire basket and pulled out of the ureter. Such an operation is often a matter of luck. One must make many attempts in order to bring the catheter with the catch device into the correct position for catching, i.e. to bring the catheter around the stone in the ureter. Because of this injuries to the mucous membrane often occur. The mucous membrane is torn. It also happens that because of multiple operations, perforations are made with the tip of the catheter tube or the wire bundle, even if this is rounded. Destruction of the urethra is also possible

Danger of infection is extremely high.

In order to simplify the complicated operation described, stone extractors have been developed which have a catch device on a flexible catheter tube, which consists of a segmented head with wings, which can be opened or closed like jaws by means of a longitudinally displaceable traction and thrusting instrument in the catheter tube (US-PS 38 27 437; 33 34 630). For the first named stone extractor the wings of the head are formed as flexible jaws, which are spanned by an elastic band and in which a

cone shaped component of the traction and thrusting instrument is axially displaceable. For the other known stone extractor, the wings of the head are claws of flexible metal, which are each equipped with an inner projection, which interacts with a cylindrical component of the traction and thrusting instrument. In both cases the operating instruments act only indirectly, by wedging effect of cam members, on the moveable wings of the catch device head, whereby an unfavorable displacement of force occurs, which can result in incorrect or inadequate radial movements of the head wings because of misjudgments by the operator, and failures in catching the ureteral stone. Multiple repetition of opening and closing of the head wings, however, indicates greater stress to the patient and increased risk.

The invention is based on the problem of improving a stone extractor of the kind cited, so that the catch device can be sensitively operated by the operator and delivers a high proportion of caught stones with minimal injury to the urethra.

This problem is solved by the invention in various ways by the features contained in the characteristic components of claims 1 and 2.

The adjustment to the traction and thrusting instrument carried out by the operator is transferred at once, directly to this by mechanical coupling of the catch device with the moveable wings of the segmented head, so that it can precisely support the catch device in such a way that this can be opened enough at the right moment during the forward movement of the stone extractor and carefully closed in order to catch the ureteral stone. The permanent connection between the traction and thrusting instrument and the leaf-shaped wings gives the operator direct information on the degree of opening or closing of the wings of the head with every movement of the traction and thrusting instrument, so that he can act with sensitivity and the ureteral stone can be caught and drawn out of the ureter in a safe and gentle way. The cuplike shell-shaped design of the head allows a sufficiently large breadth of opening of the jaws to catch even large urethral stones.

The stone extractor is introduced into the ureter up to the ureteral stone, with the shell-shaped head held closed. In this state it does not project or hardly projects out of the catheter tube. Then the head is brought to open position by pressing the thrusting instrument so that open jaws are formed in the direction of the ureteral stone. Through the opening of the head the walls of the urethra are widened all around. This has the effect that even stones tightly wedged in the urethra can come loose by themselves. Because in this way, the urethra receives a large open cross section under the urethral stone, which can often cause the urethral stone to slide by itself into the opened jaws of the head. Then the open jaws of the head can be closed again by means of the traction instrument, whereby the urethral stone is located completely or at least partially inside the head. When the urethral stone is further pulled out of the urethra, the inner wall of the urethra does not come into further contact with the stone, because the parts of the head are in between. Therefore the roughness of the stone cannot cause injuries or irritation and the like to the mucous

membrane. The ureteral stone, clamped by the more or less closed head, can be pulled slidingly out of the ureter. Thereby the mucous membrane of the ureter is not irritated much, and so the process of removing the ureteral stone from the urethra remains essentially bloodless.

The problem cited is also favorably solved by the feature of the invention characterized in claim 3.

This development of a stone extractor improves a medical device for removing ureteral stones according to DE-OS 21 04 673, in which the catch device is formed from a cuplike, elastic end component of the flexible catheter tube, the opening of which can be constricted. With the known stone extractors the catheter tube and the cuplike end component are formed with double walls. If an appropriate medium is introduced between the double walls of the catheter tube and the end component, then the end component unfolds and the opening receives its largest diameter shape. If pressure is reduced on the medium which has flowed into the end component, a shrinkage of the end component is achieved, which clamps the ureteral stone firmly in the end component. With this stone extractor it is practically impossible for the operator to improve the catch result with small adjustments to the end component serving as the head of the catch device, because the pressure medium allows only full opening of the swollen end part or its relaxation. The holding power of the relaxed end component for the urethral stone must be applied by the ureter, whereby there is a danger of the urethral stone slipping out of the end component. In addition, this device is susceptible to injury of the tube wall by sharp edges from a urethral stone with the result that the pressure medium escapes prematurely.

The stone extractor design characterized in claim 3 is economical, because it is inexpensive to produce in relation to the fulfillment of the requirements of sensitive operation and high stone results. Since its circumference is closed, adjustment of the end component is achieved with the least possible irritation of the ureter mucous membrane. The end component is a shell-shaped head developed as a funnel. By pulling

on the pull cord the conical section on the free end can be pulled together in opposition to its elastic spreading action. In this position the cuplike head of the stone extractor can be closed in such a way that it can easily by introduced into the urethral orifice and pushed into the urethra.

The invention is explained below on the basis of the implementation examples depicted in the drawings.

Fig. 1, 2 and 3 depict a first embodiment of a stone extractor with catch device in three different phases in longitudinal section and cutout, schematically.

Fig. 4 through 7 depict details of the catch device of **Fig.** 1 through 3, whereby **Fig.** 4 and 5 show side and top views, while **Fig.** 6 and 7 show the movement mechanism in section through the catch device.

Fig. 8, 9 and 10 depict a second embodiment of the catch device in diagram and in section diagramatically and in section, schematically.

Fig. 11 through 13 depict a third possible embodiment of a jawlike catch device, which can be opened and closed, in diagram and in schema.

With a urolithiasis complications and complaints

often result from the fact that a stone **1** which has left the kidney **2**, has become lodged because of wedging or the like in the urethra **3** which leads to the bladder **4**. If a natural departure of the stone from the urethra cannot be achieved, a surgical-instrumental intervention is often given for treatment of urolithiasis. For this a catheter tube **5** is used, which is to be inserted in the ureter and has a catch device **6** on the forward end. The catch device **6** has a shell shaped head **7**, which can be opened and closed by means of a traction and thrusting instrument **8**, for instance a flexible cable, inserted into the catheter tube **5**.

With the embodiment of **Fig.** 1 through 7 the shell shaped catch device is formed by curved leaf-shaped wings **9**, which run inward in cross section and swivel around the transverse axis **10**, which are mounted in the catheter tube **5**. The leaf shaped wings **9** can be provided with attachments **11** on the inside, which are loosely connected by tabs **12** to the above component **13** of the flexible traction and thrusting instrument **8**.

In the closed position of the leaf-shaped wings **9** these essentially form a dome-shaped continuance of the catheter tube **5**, whose wall can be marginally strengthened on the end. This is however not absolutely necessary. By pulling the traction and thrusting instrument **8** on the back end of the catheter tube **5**, over which the traction and thrusting instrument **8** is taken out and can be provided with a lock, the head **7** can be held in the closed position by force. After introduction of the catheter tube **5** into the ureter **3** up to just before the stone **1**, the leaf-shaped wings **9** can be opened by force by pressing the traction and thrusting instrument **8** against the catheter tube **5** which is held stationary, so that the wings **9** are spread apart and form a jawlike opening **14**. Hereby a gentle widening of the wall of the urethra **3** is made possible (**Fig.** 2), and even far enough that the stone **1** can detach itself from the wall of the ureter. Thereby it is possible for the stone to fall as a free piece into the opened jaws **14** of the catch device **6**. However one can also grasp and clamp the stone by making the closing movement of the leaf-shaped wings **9**. Closing of the leaf-shaped wings occurs through pulling out the traction and thrusting instrument **8** with respect to the catheter tube **5**, whereby the stone which has fallen in is enclosed by the wings **9** or can be held only partially clamped. Then the catheter tube **5** together with the catch device **6** and the stone **1** is taken out of the urethra **3**.

The catch device **16** of **Fig.** 8 through 10 concerns opening and closing of the leaflike wings **17** in the form of a spacially shaped iris diaphragm. The wings **17** overlap each other somewhat on either side. They carry attachments **18** on the inside, between which elastic parts, e.g. a helical spring **19** or a special buffer of rubber-elastic material, can be mounted, whereby a ring shaped wire **20** can be provided as a guide for the helical springs **19**. The wings **17** are mounted with their bottom part **17*a***, which runs in an appropriate conical direction, in a stiff and rigid conical section **5*a*** of the catheter tube **5**. The wings **17** can be provided on the bottom end with a ring shaped rim **17*b*** which

curves inward, gripped by a protruding collar **8*a*** of the traction and thrusting instrument **8**. The wings **17** are pushed apart by the elastic parts arranged between the wings **17**, so that wide open jaws **21** are formed. By pulling the traction and thrusting instrument **8** in respect to the catheter tube **5** the wings **17** in section **5*a*** are more or less pulled in, so that the wings **17** push more or less together against the action of the helical springs **19** like an iris diaphragma and are held by force in this position. By the development of the wings **17** it can be achieved, that the wings **17** join together tightly with their free ends in the closed position, which improves the introduction of the catheter tube **5** into the urethra.

For the design of the catch device **33** of **Fig.** 11 through 13, the catheter tube **5** is provided on its free end with an elastic section **34** running conically outwards, which in its original form makes open jaws. A pull cord **35** running around in a ring can be connected to the cone-shaped section **34**, which is attached with its end **35*a*** to the section **34**. The pull cord can hereby be displaceably located in the section wall **34**. The other part **35*b*** of the pull cord **35** leads through a prepared borehole to the inside of the catheter tube **5**, whereby the next part **35*c*** goes to the hollow space of the catheter tube **5** and can be brought out of the catheter tube to an operating lock. If the pull cord is pulled outwards from the catheter tube, the ring-shaped part of the pull cord **35** causes the conical section **34** to pull together, so that the catheter tube **5** can easily be inserted into the urethra. As soon as one reaches the stone **1** lodged in the urethra **3**, the pull cord **35** is allowed to relax, at which point the conical section **34** of the catheter tube **5** moves outwards with its own springs and wide jaws **36** are formed. By means of the widening of the urethra the stone **1** can go

into the jaws. By pulling the pull cord **35** the stone **1** is held clamped, whereupon the catheter tube **5** together with the stone can be pulled out of the urethra.

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4 pages of drawings follow

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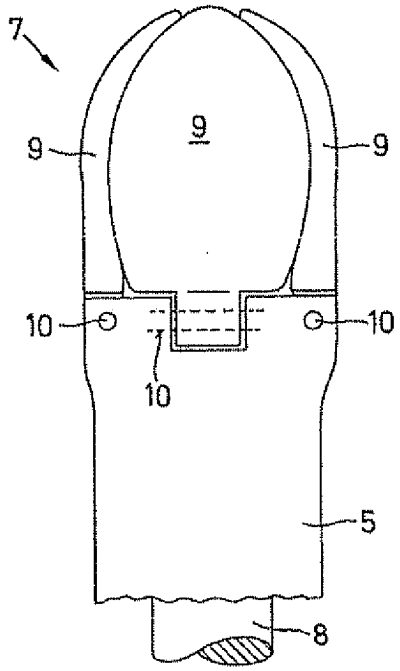
FIG. 4



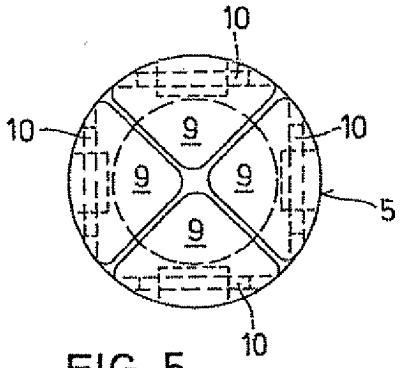
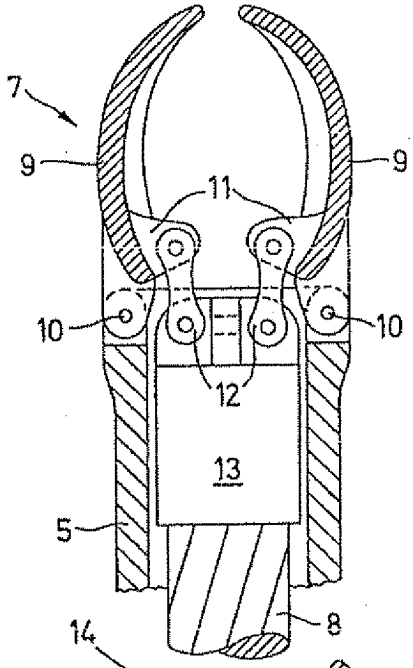


FIG. 5

FIG. 6



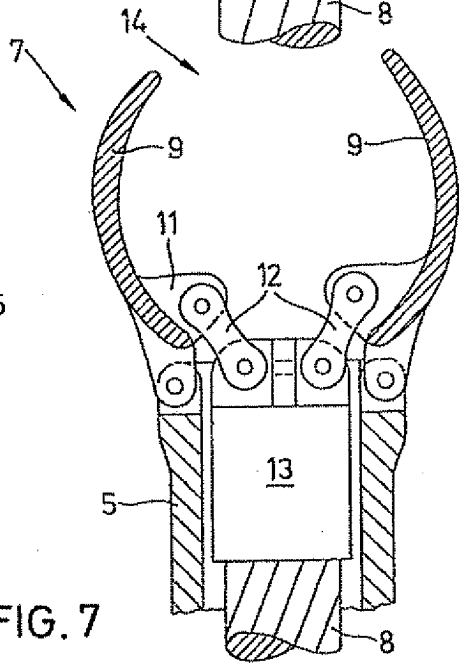


FIG. 7

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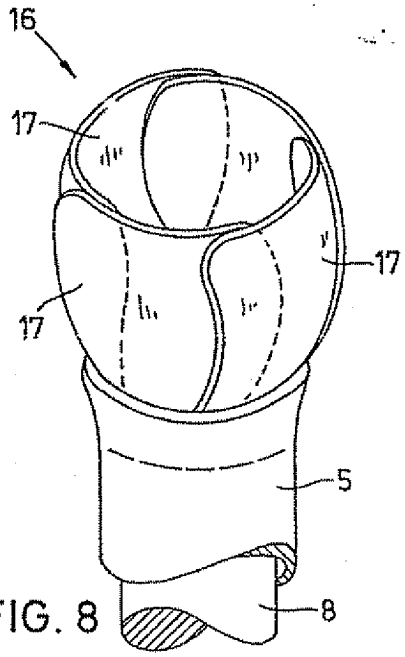

FIG. 8

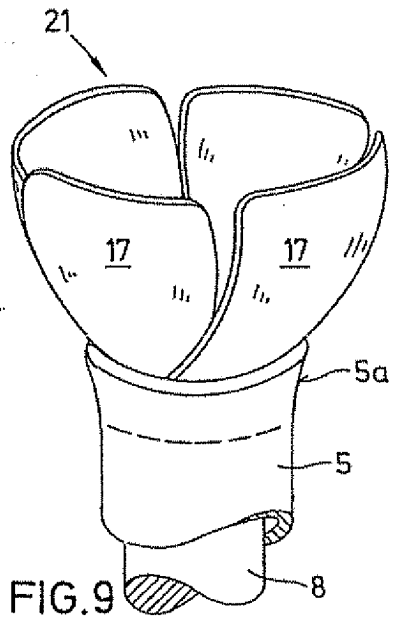

FIG.9

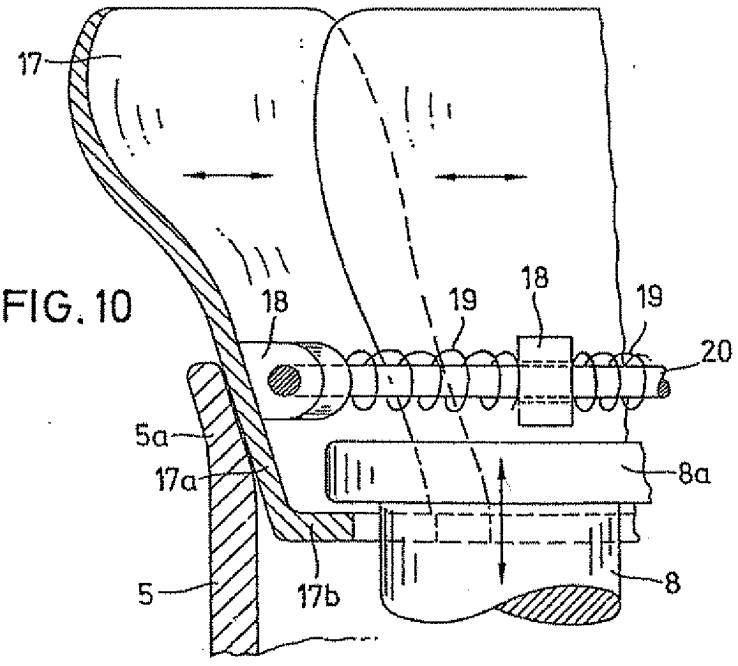

FIG. 10

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FIG. 13

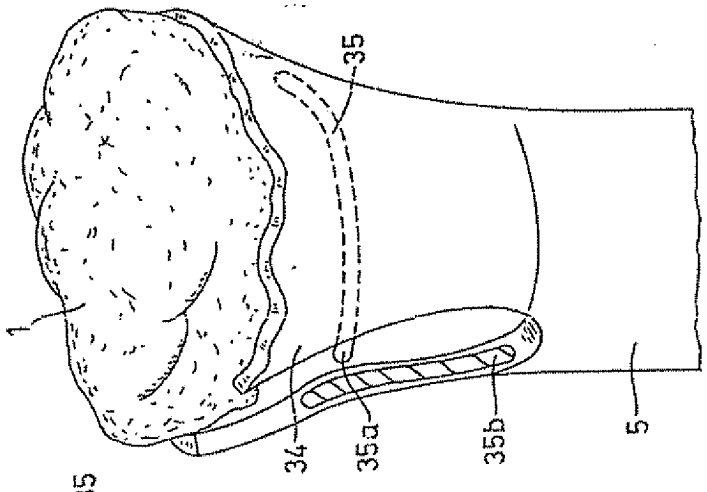

FIG. 11

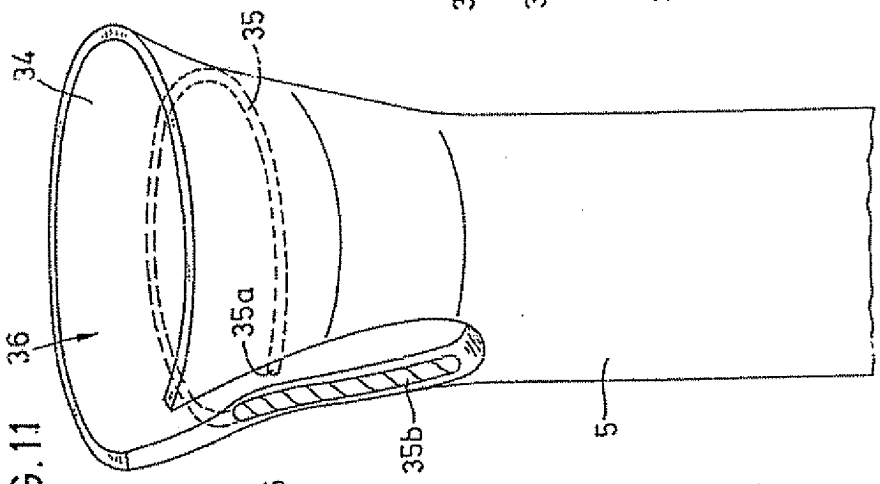

FIG. 12